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COMPLEX MAGNETIC SUSCEPTIBILITY

OF A PARAMAGNETIC AT FIGH FREQUENCIES

I. G. Shaposhnikov

A Digest/

Consider an ideal paramagnetic with pure spin magnetism in a complex external magnetic field H = Hot h · exp (iot), whose constant component Ho is directed along the z-axis while the variable component is along the x-axis (the case of perpendicular fields).

The x-component of the alternating portion of magnetization is next written down as given in the theory of thermodynamics, namely as a product of (a) a conjugate of the complex susceptibility and (b) h - eap (iiit).

The real and imiginary parts of the above complex susceptibility (chi) are expressed as products of (a) static susceptibility (equal to b/T_{\odot} where h is the Curie constant and To is the lattice temperature considered constant) and (b) a quantity involving the spin-spin relaxation time, the constant component Ho above, and the ratio of the magnetic and mechanical moments for paramagnetic particles.

Unfortunately, the spin-spin time as a function of T_0 and H_0 is not given by present-day theory. Therefore, the above-indicated real and imaginary parts of susceptibility (chi) are only partially expressed as functions of T_0 and H_0 .

However, an experimental curve is known, which gives the imaginary part of the complex susceptibility (chi) as a function of H, for given To and oscillator frequency G. Again, the spin-spin time as a function of H₀ can also be found which satisfies the above theoretical formulas of thermodynamics.

Thus, it turns out that the spin-spin time must increase slowly with Ho and approach asymptotically a certain constant. This apparently means that the spin-spin time can be considered independent of $R_{\rm c}$ if the frequency ω is sufficiently.

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Hence, this work assumes the oscillator frequency ω is large in order to simplify the study of the behavior of the curves describing the real and imaginary parts of the complex susceptibility (chi) as functions of Ho, which is the purpose of this work.

From these and other considerations, it is possible to estimate the form of the curves of real and imaginary susceptibilities versus H_0 . It appears that the imaginary part of susceptibility (chi) assumes the form of a symmetrical Gaussian error curve (that is, the normal distribution curve) with a maximum at a certain value H_0 of H_0 , equal to the oscillator frequency divided by the ratio of magnetic and mechanical moments. The curve of real susceptibility versus H_0 has a minimum to the left of the above-mentioned H_0 and a maximum to the right of H_0 ; the point of inflection is at H_0 uself.

Actually, only qualitative results are known, since the ratio of the real and imaginary susceptibilities to the static susceptibility were studied. Further experimental data on the absolute values of the real and imaginary susceptibilities are necessary to verify results.

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